

Study of $a_0^0(980) - f_0(980)$ mixing at BESIII

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In this talk, we present direct measurements of $a_0^0(980) - f_0(980)$ mixing in the processes $J/\psi \rightarrow \phi f_0(980) \rightarrow \phi a_0^0(980) \rightarrow \phi \eta \pi^0$ and $\psi' \rightarrow \gamma \chi_{c1}, \chi_{c1} \rightarrow \pi^0 a_0^0(980) \rightarrow \pi^0 f_0(980) \rightarrow \pi^0 \pi^+ \pi^-$ with 2.25×10^8 J/ψ data and 1.06×10^8 ψ' data at BESIII.

1 Introduction

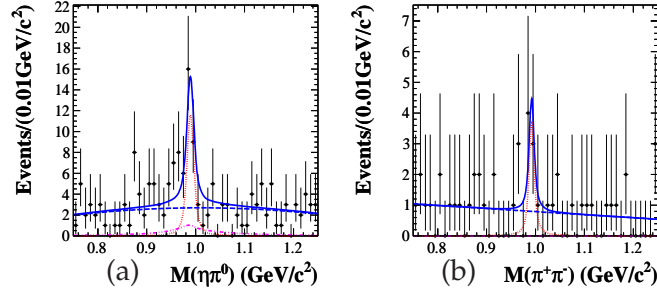
BESIII/BEPCII [1] is a major upgrade of the BESII detector and BEPC accelerator. The primary physics purposes are aimed at the study of hadron spectroscopy and τ -charm physics.

The nature of the scalar mesons $a_0^0(980)$ and $f_0(980)$ has been a hot topic in light hadron physics for many years. The mixing between $a_0^0(980)$ and $f_0(980)$ is expected to shed light on the nature of these two resonances. In this talk, we present the recent result from the study of $a_0^0(980) - f_0(980)$ mixing at BESIII [2].

2 Study of $a_0^0(980) - f_0(980)$ mixing at BESIII

The leading contribution to the isospin-violating mixing transition amplitudes for $f_0(980) \rightarrow a_0^0(980)$ and $a_0^0(980) \rightarrow f_0(980)$ are shown to be dominated by the difference of the unitarity cut which arises from the mass difference between the charged and neutral kaons. As a consequence, a narrow peak of about $8 \text{ MeV}/c^2$ is predicted between the charged and neutral kaon thresholds. Using the samples of 2.25×10^8 J/ψ and 1.06×10^8 ψ' events, we perform direct measurements of $a_0^0(980) - f_0(980)$ mixing in the processes $J/\psi \rightarrow \phi \eta \pi^0$ and $\psi' \rightarrow \gamma \chi_{c1}, \chi_{c1} \rightarrow \pi^0 a_0^0(980) \rightarrow \pi^0 f_0(980) \rightarrow \pi^0 \pi^+ \pi^-$.

FIG.(a) shows the fitting results of $\eta \pi^0$ mass spectrum recoiling against ϕ signal in $J/\psi \rightarrow \phi f_0(980) \rightarrow \phi a_0^0(980) \rightarrow \phi \eta \pi^0$. The dotted line shows the mixing signal. The dash-dotted line denotes the $a_0^0(980)$ from virtual photon or $K^* \bar{K}$ loop. The dashed line is a polynomial background constrained to the ϕ sideband. The significance of $f_0(980) \rightarrow a_0^0(980)$ mixing signals is 3.3σ . The mixing branching ratio is determined to be $\mathcal{B}(J/\psi \rightarrow \phi f_0(980) \rightarrow \phi a_0^0(980) \rightarrow \phi \eta \pi^0) (< 5.4 \times 10^{-6} \text{ at the } 90\% \text{ C.L.})$.



For $a_0^0(980) \rightarrow f_0(980)$ transition, the mass spectrum of $\pi^+\pi^-$ in the χ_{c1} mass window is fitted in a similar style, shown in FIG. (b). The significance of $a_0^0(980) \rightarrow f_0(980)$ mixing signals is 1.9σ . The mixing branching ratio is determined to be $\mathcal{B}(\psi' \rightarrow \gamma \chi_{c1} \rightarrow \gamma \pi^0 a_0^0(980) \rightarrow \gamma \pi^0 f_0(980) \rightarrow \gamma \pi^0 \pi^+ \pi^-) (< 6.0 \times 10^{-7}$ at the 90% C.L.). The mixing intensities ξ_{fa} for $f_0(980) \rightarrow a_0^0(980)$ transition and ξ_{af} for $a_0^0(980) \rightarrow f_0(980)$ transition are defined and calculated as:

$$\xi_{fa} = \frac{\mathcal{B}(J/\psi \rightarrow \phi f_0(980) \rightarrow \phi a_0^0(980) \rightarrow \phi \eta \pi^0)}{\mathcal{B}(J/\psi \rightarrow \phi f_0(980) \rightarrow \phi \pi^+ \pi^-)} (< 1.1\% \text{ at the 90\% C.L.}),$$

$$\xi_{af} = \frac{\mathcal{B}(\psi' \rightarrow \gamma \chi_{c1} \rightarrow \gamma \pi^0 a_0^0(980) \rightarrow \gamma \pi^0 f_0(980) \rightarrow \gamma \pi^0 \pi^+ \pi^-)}{\mathcal{B}(\psi' \rightarrow \gamma \chi_{c1} \rightarrow \gamma \pi^0 a_0^0(980) \rightarrow \gamma \pi^0 \pi^0 \eta)} (< 1.0\% \text{ at the 90\% C.L.}).$$

3 Summary

A new facility for physics in the charm- τ region BEPCII/BESIII has become operational. With the world's largest samples of J/ψ and ψ' collected at BESIII, the direct measurement of a_0 and f_0 mixing is performed for the first time. The measurements will be very helpful for pinning down the natures of $a_0^0(980)$ and $f_0(980)$.

References

- [1] "Physics at BESIII", Edited by K. T. Chao and Y. F. Wang, Int. J. Mod. Phys. A **24**, No.1 (2009) supp.
- [2] M. Ablikim *et al.* [BESIII Collaboration], Phys. Rev. D **83**, 032003 (2011).
- [3] J. J. Wu, Q. Zhao, and B. S. Zou, Phys. Rev. D **75**, 114012 (2007).
- [4] C. Hanhart, B. Kubis, and J. R. Pelaez, Phys. Rev. D **76**, 070428 (2007)
- [5] J. J. Wu and B. S. Zou, Phys. Rev. D **78**, 074017 (2008).